

## IN THE CLAIMS

Please cancel claims 2, 19, 21 without prejudice or disclaimer. Amend claims 1, 3, 4, 18, and 20.

Please add claims 36-48 as shown below. A complete claim listing is shown below:

1. (Currently Amended) A sorption pump comprising:  
at least 2 adsorption layers;  
wherein each of the at least 2 adsorption layers~~an adsorption layer comprising~~ comprises  
an adsorption mesochannel containing adsorption media; and  
at least 3 heat exchanger layers  
wherein each of the at least 3 heat exchange layers ~~is a heat exchanger~~ in thermal contact  
with ~~the~~ an adsorption layer;  
wherein ~~the~~ each of the at least 3 heat exchange layers ~~heat exchanger~~ comprises at least  
one microchannel;  
wherein the adsorption layers are interleaved with the heat exchange layers; and  
wherein ~~the~~ each of the at least 2 adsorption layers~~adsorption layer~~ has a gas inlet such  
that gas directly contacts the adsorption media without first passing through a contactor.
2. (canceled)
3. (Currently Amended) The sorption pump of claim 1 wherein each of the at least 2  
adsorption layers~~the adsorption layer~~ comprises a plastic and wherein each of the at least 3 heat  
exchange layers ~~the heat exchanger layer~~ comprises a metal.
4. (Currently Amended) The sorption pump of claim 1 further comprising, in each of the at  
least 2 adsorption layers, a gas outlet separate from the inlet;  
wherein the outlet is disposed such that a gas stream can flow through the inlet, through  
the adsorption media and out the outlet.

5. (Original) The sorption pump of claim 4 wherein the pump possesses capability such that, if the adsorption media is replaced with an equal volume of 13x zeolite, with a bulk density of 0.67 grams per cubic centimeter, and then saturated with carbon dioxide at 760 mm Hg and 5 °C and then heated to no more than 90 °C at 760 mm Hg, then at least 0.015 g CO<sub>2</sub> per mL of apparatus is desorbed within 1 minute of the onset of heating.

6. (Original) Gas adsorption and desorption apparatus comprising:  
at least one adsorption layer comprising an adsorption mesochannel containing adsorption media; and  
at least one heat exchanger in thermal contact with the adsorption layer;  
wherein the adsorption mesochannel has dimensions of length, width and height;  
wherein the height is at least 1.2 mm; and  
wherein the apparatus possesses capability such that, if the adsorption media is replaced with an equal volume of 13x zeolite, with a bulk density of 0.67 grams per cubic centimeter, and then saturated with carbon dioxide at 760 mm Hg and 5 °C and then heated to no more than 90 °C, at 760 mm Hg, then at least 0.015 g CO<sub>2</sub> per mL of apparatus is desorbed within 1 minute of the onset of heating.

7. (Original) The apparatus of claim 6 comprising:  
at least 2 adsorption mesochannels, each containing adsorption media, interleaved with at least 3 heat exchanger layers, each heat exchanger layer comprising at least one microchannel.

8-17. (Canceled)

18. (Currently Amended) Gas adsorption and desorption apparatus comprising:  
at least 4 adsorption/desorption cells

each cell comprising at least one adsorption mesochannel in thermal contact with at least one heat exchanger;

wherein the at least one heat exchanger comprises a microchannel heat exchanger;

wherein the adsorption channel contains adsorption media;

the apparatus connected to a heat source and a heat sink; and

conduits between each heat exchanger and the heat source and the heat sink and also

conduits between at least one heat exchanger in each cell and at least one heat exchanger in another cell.

19. (Canceled)

20. (Currently Amended) A sorption pump, comprising:

an adsorption layer comprising an adsorption channel containing adsorption media; and

a mesochannel heat exchanger in thermal contact with the adsorption layer;

wherein the mesochannel heat exchanger has a fluid flowing therethrough that has a high thermal diffusivity, such that the characteristic heat transport time of the fluid in combination with the mesochannel heat exchanger is a value no greater than 10 seconds; and

wherein said fluid is a liquid metal or a silicone-based fluid.

21. (Canceled)

22. (Original) A multi-cell sorption pump, comprising:

at least six sorption cells; wherein each sorption cell comprises at least one adsorption layer, and at least one heat exchanger layer;

thermal connections connecting each sorption cell to at least two other sorption cells and to a heat source and to a heat sink, such that each sorption cell can cycle thermally from adsorption to desorption and back to adsorption by sequentially receiving heat from said at least two other sorption cells prior to receiving heat from the heat source, and then

sequentially giving up heat to at least two other sorption cells prior to giving up heat to the heat sink, such that thermal recuperation is provided.

23. (Canceled)

24. (Original) The multi-cell sorption pump of claim 22, wherein the heat source is selected from the group consisting of an electrical resistor, a process technology, solar power, nuclear power.

25. (Original) The multi-cell sorption pump of claim 22, where the thermal connections are heat switches.

26. (Original) The multi-cell sorption pump of claim 22, wherein the thermal connections comprise fluid loops.

27. (Original) The multi-cell sorption pump of claim 22, wherein the sorption pump incorporates mesochannel sorption channels, and wherein the sorption pump incorporates mesochannel heat exchange channels.

28-30. (Canceled)

31. (Original) The sorption pump of claim 5 where the adsorption media is heated to 90°C by flowing warm water at 90°C through the heat exchange channels.

32-35. (Canceled)

36. (New) An air treatment system comprising the sorption pump of claim 1, comprising:

an oxygen source;

a first sorption cell comprising the sorption pump of claim 1 wherein the adsorption media comprises a water adsorbent;

a second sorption cell comprising the sorption pump of claim 1 wherein the adsorption media comprises a water adsorbent;

a third sorption cell comprising the sorption pump of claim 1 wherein the adsorption media comprises a CO<sub>2</sub> adsorbent; and

a fourth sorption cell comprising the sorption pump of claim 1 wherein the adsorption media comprises a CO<sub>2</sub> adsorbent.

37. (New) A sorption pump, comprising:

an adsorption layer comprising an adsorption channel containing adsorption media; and  
a mesochannel heat exchanger in thermal contact with the adsorption layer;  
wherein the mesochannel heat exchanger has a fluid flowing therethrough that has a high thermal diffusivity, such that the characteristic heat transport time of the fluid in combination with the mesochannel heat exchanger is a value no greater than 10 seconds;  
wherein adsorption media fills at least 60% of the cross section of at least one portion of the adsorption channel.

38. (New) The sorption pump of claim 37 wherein the adsorption channel has a height of 1.2 mm to 1 cm.

39. (New) The sorption pump of claim 37 wherein the adsorption channel has a height of 1 cm or less, and wherein adsorption media fills at least 90% of the cross section of at least one portion of the adsorption channel.

40. (New) The sorption pump of claim 1 wherein the adsorption mesochannels in each of the at least two adsorption layers are at least 50% filled with adsorption media.
41. (New) The sorption pump of claim 1 wherein the each of the at least two adsorption layers comprise a plastic structural material, and wherein each of the at least 3 heat exchanger layers comprise a metal structural material.
42. (New) The sorption pump of claim 1 wherein the each of the at least two adsorption layers comprise adsorption media and interspersed thermally conductive materials.
43. (New) The sorption pump of claim 1 wherein the each of the at least two adsorption layers comprise an adsorption mesochannel that is cut completely through the adsorption layer.
44. (New) The sorption pump of claim 1 wherein the each of the at least two adsorption layers comprise an adsorption mesochannel comprising an adsorption media in the form of particles, pellets, foams, felts, or honeycombs.
45. (New) The sorption pump of claim 7 wherein the each of the at least two adsorption layers comprise a plastic structural material, and wherein each of the at least 3 heat exchanger layers comprise a metal structural material.
46. (New) The sorption pump of claim 6 wherein the adsorption media is in the form of particles, pellets, foams, felts, or honeycombs.
47. (New) The sorption pump of claim 6 wherein the adsorption mesochannel is at least 50% filled with adsorption media.
48. (New) The sorption pump of claim 6 wherein adsorption media fills at least 60% of the

cross section of at least one portion of the adsorption channel.